

## **CLASS 416, FLUID REACTION SURFACES (I.E., IMPELLERS)**

### **SECTION I - CLASS DEFINITION**

This class provides the locus for all fluid impellers\* not elsewhere classifiable.

- (1) Note. The working fluid\*, which is acted on by or acts upon the impeller, may be a liquid or gas.  
This class also takes miscellaneous sub-combinations of impellers and accessory devices when the subcombination or accessory is limited in use to the combination or not elsewhere classifiable.

### **SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**

#### **GENERAL PLACEMENT OF PATENTS BASED ON A LINE APPLICABLE TO AN ART GROUP**

Impellers\* combined with structure or art devices are found in many classes wherein the impeller function is incidental or ancillary to the function of the combination. In those instances where an impeller relates to combinations in a similar manner in more than one class, a single line has been established to determine the placement of art.

No attempt has been made to review the classification of all patents found in classes which may involve an impeller as an element of the class subject matter. Thus, it is to be noted that although the original classification of a patent may not be consistent with a line set out below, currently issuing patents will be classified on the basis of the stated lines and the various patents currently classified inconsistent therewith are to be transferred when noted.

**Vehicle Propulsion** - This class provides for the combination of a vehicular device and an impeller\* not otherwise classified wherein the impeller is arranged to propel the device and no more structure of the device is claimed than is necessary to mount the impeller inclusive of any impeller motor or drive means. Any additional recitation of vehicle structure or any modification of the vehicular device will require classification in the proper vehicle class.

- (1) Note. The structure of the vehicle is considered to be significantly claimed in any

instance wherein the impeller, its power plant, motor or drive mechanism is mounted or located (1) in a specific relation with respect to the vehicular device as a unit (e.g., perpendicular to longitudinal axis) or (2) on or in a relationship to a specific vehicle part (e.g., wing or keel).

- (2) Note. Merely locating the impeller or drive means by broad reference to the vehicular device is not sufficient to exclude the patent from classification in this class (e.g., attached at side, front, rear, bow, stern, top, bottom, right, left, within or without the vehicle or at the water line). However, additional relationships will be sufficient for classification in the proper vehicle class (e.g., one impeller on each side or an impeller drive mounted within the vehicle rearwardly of the center of gravity).
- (3) Note. Terms such as deck, cabin, wing, fender, keel and gunwale are considered to be specific vehicle parts, per se, while fore, aft, bow, stern, hull or fuselage are not, of themselves, so considered.

### **SECTION III - REFERENCES TO OTHER CLASSES**

#### **SEE OR SEARCH CLASS:**

- 60, Power Plants, subclasses 495+ for a motor operated by the buoyancy of a fluid or by the vertical component of tides or waves.
- 74, Machine Element or Mechanism, for the combination with a named impeller\* which is recited as a nominal load, i.e., no detail of the impeller or its relationship with the gearing or transmission is recited.
- 244, Aeronautics, for the combination of impellers\* and aircraft structure where more aircraft details are recited than is necessary to mount the impellers.
- 277, Seal for a Joint or Juncture, for the combination of a sealing means between relatively moving parts, one of which may be an impeller\* shaft, where no specific details are recited of the impeller or other fluid reaction surface mounted on the shaft.
- 366, Agitating, appropriate subclasses for (1) the combination of an agitating impeller\* and a confining means (e.g., mixing chamber, etc.), (2) the combination of an agitating impeller

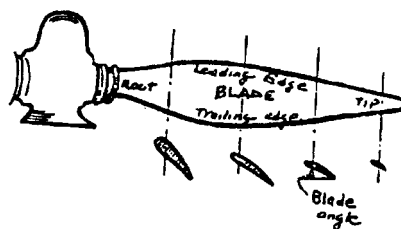
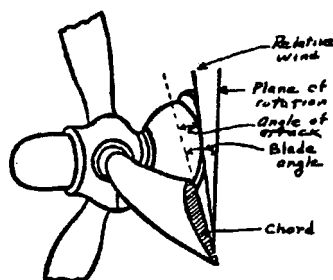
- and means functionally related to confining means for a fluid being agitated (e.g., structure which scrapes chamber walls; support specialized for use in or on a mixing chamber or closure therefore feed or discharge means to point of agitation; etc.), or (3) an impeller per se which is disclosed solely for agitating viscous or particulate solids, such as dough or sand.
- 384, Bearings, for the combination of a broadly recited impeller\* and a bearing element supporting the impeller shaft. The recitation of a "blade" impeller is considered to be a detail sufficient to exclude a claim from Class 384 and classify it in Class 416.
- 415, Rotary Kinetic Fluid Motors or Pumps, for a fluid reaction surface (impeller\*) and a means for guiding a fluid to, around or from the surface. The relationship between Classes 415 and 416 is that of combination - subcombination respectively. However, patents in Class 415, subclass 182.1 and 208.1 through 232, which claim a nominally recited casing and particular runner structure have been cross referenced to Class 416. For a complete search of runner or impeller structure, other appropriate subclasses in Class 415 should be considered. A patent including claimed means for confining, guiding or directing the fluid to or from an impeller\* will be classified in Class 415. A waterfall has been determined to be directed fluid and an impeller claimed in combination therewith is classified in Class 415.
- 440, Marine Propulsion, appropriate subclasses for the combination of an impeller\* and significant ship structure and see Vehicle Propulsion above for a detailed statement of the line with vehicle classes in general.

- (1) Note. As an exception to the line set out above, the collection of portable propellers (e.g., outboard motor type) in subclasses 53+ of Class 440 has not been cleared at this time and such disclosures will continue to be there classified.

## SECTION IV - GLOSSARY

The following terms or words, used throughout the titles and definitions, are set forth with the meaning each is to have in this class. Throughout this bulletin an asterisk(\*) following the first occurrence of the word or term

in any title, definition or note that reference should be made to this glossary for the specific meaning thereof.



### ANGLE OF ATTACK

The acute angle between the chord\* of a working member\* and the velocity vector of the working fluid\* flow relative to the member. See Figure I.

### BLADE

A working member\* which has a thickness dimension substantially less than its width or length, the thickness being generally uniform from edge to edge.

### BLADE ANGLE

The acute angle between the chord\* of any section of a rotating working member\* and its plane of rotation. As the blade angle usually varies from the hub to the tip, the U.S. custom is to designate blade angle numerically as that angle occurring at 75% of the radial distance from the hub to the tip. See Figures I and II.

### CARRIER

A Load bearing structure (e.g., hub, etc.) which mounts one or more working members\* and which, at least in part, partakes of the motion of the member.

### CHORD

The straight line in a plane normal to the longitudinal axis of a working member\* joining the leading and trailing edges of the member\*. See Figure I.

#### CONTROLLABLE PITCH

Comprises means for adjusting blade angle\* during impeller\* operation.

#### COLLECTIVE PITCH CHANGE

Wherein the blade angles of all working members\* of a single impeller are adjusted simultaneously.

#### CYCLIC PITCH CHANGE

Wherein the blade angle of each working member of an impeller is varied for only a predetermined limited portion of each working cycle, each working member being similarly adjusted in sequence as it, in turn, reaches the predetermined portion of the working cycle. though the impeller need comprise only a single working member.

#### IMPELLER

A device comprising at least one working member\* which functions to react with a working fluid\* such that action movement of the member causes reaction movement of the fluid or action movement of the fluid causes reaction movement of the working member. In its simplest form, a single impeller is considered to comprise a working member or members and any parts rigidly connected therewith whereby the impeller is supported for movement. In the case of an impeller having a working member which has relative movement with respect to another impeller part or another working member, the definition of impeller is considered to include those mechanical elements which permit or cause relative motion of the working members and at least partly partake of the motion of the working member and are closely associated therewith to form a unitary device having a unitary impelling function.

In view of the many embodiments an impeller may have, it is not possible to more definitely define the concept, but in most cases it will be apparent which elements forms part of the impeller and which elements, on the other hand, comprise support\* means for the impeller of means for transmitting power to or from the impeller. In those subclasses in which the precise limits of the impeller, per se, are apt to be troublesome, an effort is made to define the impeller concept in more

detail insofar as it concerns the concept of the particular subclass.

#### PITCH (GEOMETRICAL)

The distance an element of a rotating impeller\* would advance in one revolution if it were moving along a helix having an angle equal to the impeller blade angle\*.

#### SUPPORT

A structure which bears the weight of an impeller\* to maintain it in operative position. The support does not partake of the working motion of the impeller (in this respect the support is different from the carrier\*) but may be adjustable to various positions of use or have movement concurrent with the impeller movement as that of a rotatable or oscillating fan support.

#### WORKING FLUID

An unconfined or undirected fluid which acts or reacts with a working member\* such that movement of the fluid causes relative movement of the member or movement of the member causes relative movement of the fluid. The fluid may be quiescent or flowing and either natural (e.g., wind) or artificial (e.g., combustion gas). A patent including claimed means for confining, guiding or directing the fluid to or from an impeller\* will be classified elsewhere. A waterfall has been determined to be directed fluid and an impeller claimed in combination therewith is classified elsewhere. See References to Other Classes, above.

#### WORKING MEMBER

A unitary means of which at least one surface functions to act or react with a working fluid\* such that movement of the means causes movement of the fluid or movement of the fluid causes movement of the means. The working member is most commonly designated as a blade, bucket or vane.

#### SUBCLASSES

- 1 This subclass is indented under the class definition. Method including a step relating to the operation or use of impeller\* structure.
  - (1) Note. This class does not provide for a claim relating to apparatus for manufacture or process of manufacture of an impeller. Where a product of manufacture (i.e., impeller) claim and either or

both an apparatus for manufacture claim or process of manufacture claim are contained in the same patent, the patent will be classified here in the appropriate article subclass and cross-referenced to the appropriate fabricating class.

**SEE OR SEARCH CLASS:**

29, Metal Working, subclass 23.51 and 889+ for apparatus and processes, respectively, for making impellers methods for making impellers.

**2** This subclass is indented under the class definition. Apparatus wherein some portion of an impeller\* or the means connecting it to a support\* comprises (1) a weakened zone or connecting part whereby destruction or separation of the apparatus due to external forces occurs in a predetermined manner or (2) a fusible zone or connecting part whereby excessive heat effects predetermined destruction or separation of the apparatus.

**3** This subclass is indented under the class definition. Apparatus wherein an impeller\* is caused to operate by direct response of one or more working members\* to an electrical or magnetic effect (e.g., the working member functions like the armature of an electric motor).

**4** This subclass is indented under the class definition. Apparatus comprising a rotary working member\* having a smooth substantially uninterrupted circumferentially continuous skin surface (e.g., cylinder) which contacts the working fluid\* such that reaction between the member and the fluid occurs solely as a result of friction contact therebetween.

(1) Note. The friction contact between the working member and the working fluid may be for the purpose of driving the member or pumping the fluid or, in the case of a magnus rotor exerting a lateral thrust on the apparatus by reason of the unbalanced or asymmetrical distribution of fluid pressures about the circumference of the working member (generally a cylinder) resulting from a layer of fluid which is more or less adherent to the surface of the member, moving at one side of the rotary member in a direction con-

trary to that of the flowing fluid and at the opposite side of the member in the same direction as the fluid flow.

**SEE OR SEARCH CLASS:**

198, Conveyors: Power-Driven, subclass 643 for an endless belt or chain-like member adapted to lift a viscous fluid from a body thereof as a result of the property of the fluid to adhere to the member.

244, Aeronautics, subclass 10 and 21 for cylindrical rotor sustaining means combined with aircraft.

415, Rotary Kinetic Fluid Motors or Pumps, subclass 90 for similar apparatus having medium fluid confining or directing means.

**5** This subclass is indented under the class definition. Apparatus comprising an impeller\* in combination with a light producing means.

**SEE OR SEARCH CLASS:**

362, Illumination, appropriate subclasses and the notes to the definitions of such subclasses, for the combination of an illuminating means with a device other than an impeller.

**6** This subclass is indented under the class definition. Apparatus wherein the impeller\* is driven by a working fluid in an intermittent rhythmic flow, as ocean waves, or made up of two or more different flowing mediums, as wind and stream flow.

**7** This subclass is indented under the class definition. Apparatus wherein the carrier\* of an impeller\* comprises an endless, elongated flexible member (e.g., chain or belt, etc.), which supports one or more working members\* through a path of operation.

(1) Note. The working member, which generally comprises a bucket or blade-like\* member supported on the endless carrier, may comprise an endless carrier having a surface configuration which functions like a blade or bucket.

**8** This subclass is indented under subclass 7. Apparatus in which at least one working member is movable during operation to a different

- or inoperative position relative to support connection with the endless flexible member without intervention of a human operator.
- 9** This subclass is indented under the class definition. Apparatus comprising an impeller\* which is acted upon by a flowing working fluid\* to produce a mechanical output and means for orienting the impeller, relative to the direction of flow.
- (1) Note. This definition does not include a mere nominal recitation of a tail vane or rudder.
- 10** This subclass is indented under subclass 9. Apparatus comprising means to cause or permit deflection of the impeller from a normal operative position aligned with the direction of working fluid flow to a position wherein the impeller is oriented at an angle to the direction of flow.
- 11** This subclass is indented under subclass 10. Apparatus wherein the impeller is mounted downstream of a vertical axis about which it swings, whereby it tends normally to be aligned with the direction of working fluid flow.
- 12** This subclass is indented under subclass 10. Apparatus wherein the impeller is oriented at an angle to the direction of working fluid flow in response to folding or feathering of a vane or rudder which tends to maintain a position aligned with the direction of flow.
- (1) Note. The vane or rudder folding or feathering includes shifting of a substantially flat vane or rudder surface from a vertical toward a horizontal plane or varying the extent of the effective flat surface.
- 13** This subclass is indented under subclass 10. Apparatus wherein the impeller is pivotally mounted to swing in a horizontal plane, the swinging movement being caused by movement of a vane or rudder relative to the impeller, which vane or rudder tends to maintain a position aligned with the direction of working fluid flow and thus urges the impeller to swing to an inoperative position.
- 14** This subclass is indented under subclass 13. Apparatus comprising means for retarding or ceasing impeller motion.
- 15** This subclass is indented under subclass 13. Apparatus wherein the impeller deflection is effected or controlled directly or indirectly by a reactive surface distinct from the impeller and normally arranged substantially transverse to the direction of working fluid flow when the impeller is headed transverse of the flow direction.
- 16** This subclass is indented under subclass 13. Apparatus wherein the impeller and the vane or rudder are so connected and arranged that they tend, by virtue of the weight of at least one of these elements, to seek one or the other of their extreme position of adjustment (i.e., operative or inoperative).
- 17** This subclass is indented under subclass 9. Apparatus wherein the impeller motion is regular and recurrent (e.g., oscillatory, rotary, etc.) and one or more working members\* thereof assume a changed operative relationship to the flowing medium at a predetermined point in the cycle of operation, the point at which the cyclic working member motion occurs being maintained at a constant fixed relation to the direction of working fluid flow.
- 18** This subclass is indented under the class definition. Apparatus comprising a rotating inertial reference means which tends to remain in its own plane of rotation due to gyroscopic stability and is so linked to an impeller\* or working member\* which normally rotates in a parallel plane that angular displacement of either rotation plane relative to the other causes a corrective force or pitch change to occur so as to return the impeller or member to rotation in a plane parallel to that of the reference means.
- 19** This subclass is indented under the class definition. Apparatus comprising an impeller consisting of a single working member and provided with a mass arranged to counter-balance the mass of the working member.
- 20** This subclass is indented under the class definition. Apparatus wherein the impelling movement of a driven impeller\* is effected in one

direction by the expulsion of a working fluid from a working member\* orifice in an opposite direction.

**SEE OR SEARCH CLASS:**

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| <p>60, Power Plants, subclasses 200.1+ for a jet reaction motors not significantly combined with an impeller.</p> <p>244, Aeronautics, subclasses 73+ for aircraft propelled by a jet motor.</p> | <p><b>21</b> This subclass is indented under subclass 20. Apparatus wherein the working member includes a combustion chamber mounted thereon or formed integral therewith.</p> <p><b>22</b> This subclass is indented under subclass 21. Apparatus comprising a rotary impeller having one or more working members projecting radially from the rotation axis and wherein a unitary structure open at its ends is mounted at the outer tip of a working member, one opening admitting air and the other expelling working fluid.</p> <p><b>23</b> This subclass is indented under the class definition. Apparatus wherein a working member* comprises a fluid reaction surface having a part or a member mounted thereon for varying the flow of fluid to or from the working member and including positive means to move the flow varying member relative to the fluid reactive surface while the working member is being operated in its intended manner.</p> <p>(1) Note. A working member comprised of relatively movable parts movable merely for the purpose of increasing or decreasing the effective operative diameter or the apparatus is not included in this definition and is classified in subclass 88 below.</p> <p><b>24</b> This subclass is indented under subclass 23. Apparatus wherein the working member impelling motion is regular and recurrent (e.g., oscillatory, rotary, etc.) and the working member or flowvarying member assumes a changed operative relationship to the working fluid at a predetermined point in the cycle of operation.</p> <p><b>25</b> This subclass is indented under the class definition. Apparatus wherein control means for operation or adjustment of an impeller* means</p> | <p>and control means for operation or adjustment of means for driving or being driven by the impeller are so correlated that actuation of one control means causes actuation of the other or said control means comprise, at least in part, structure common to both operations or adjustments.</p> <p><b>26</b> This subclass is indented under subclass 25. Apparatus wherein the impeller operation or adjustment control means comprises means for varying the blade angle* of an impeller and the control means for the impeller driving or driven means comprises brake or clutch means therefor.</p> <p><b>27</b> This subclass is indented under subclass 25. Apparatus wherein the impeller operation or adjustment control means comprises means for varying the blade angle* of an impeller and the control means for the impeller driving or driven means comprises means for varying the flow or fuel or motive fluid to an impeller drive engine or motor, at least one of the controls being actuated by means which senses a condition.</p> <p><b>28</b> This subclass is indented under subclass 27. Apparatus wherein the condition responsive control means is actuated by a means which senses a temperature state or variation.</p> <p><b>29</b> This subclass is indented under subclass 27. Apparatus wherein the condition responsive control means is actuated by a means which senses a state or variation of the intake air flow to a drive engine for the impeller.</p> <p><b>30</b> This subclass is indented under subclass 27. Apparatus wherein the control means and the condition sensing means, or both, comprise, at least in part, electrical apparatus.</p> <p><b>31</b> This subclass is indented under the class definition. Apparatus comprising a means for controlling an apparatus part without the intervention of a human attendant in response to a condition that may or may not occur, a change in such condition, a lack of such condition or the result of such condition, the operation of said control means being caused or permitted by (1) a separate means which senses the condition (2) outward radial movement of the control means or an actuating mechanism where</p> |
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said means or mechanism is mounted for rotation and the radial movement due to centrifugal force occurs at a predetermined rate of rotation, or (3) direct or transmitted response of the control means to a turning, twisting or linear force on the apparatus or part thereof.

**32** This subclass is indented under subclass 31. Apparatus wherein the controlled means comprises a brake or clutch in a transmission train driving or driven by the impeller.

**33** This subclass is indented under subclass 31. Apparatus comprising control means for two or more impellers\* wherein (1) the adjustment of one or more impellers is in response to a condition of another impeller or (2) two or more impellers are adjusted in response to a common condition sensing means.

(1) Note. An impeller which is provided merely as an element is the control system for another is not considered to be a "distinct" impeller under this definition.

SEE OR SEARCH THIS CLASS, SUBCLASS:

37, for a device comprising automatic control in response to plural condition sensing and in which one of the conditions is atmospheric pressure (density or altitude).

**34** This subclass is indented under subclass 33. Apparatus wherein at least two operatively related impellers are caused to function in a substantially identical manner to maintain a balanced condition.

(1) Note. This subclass includes the synchronization of impellers in which the adjustment of one or more impellers is in response to a condition of another impeller (known as the master) or wherein plural impellers are so adjusted in response to a master control unit.

SEE OR SEARCH CLASS:

60, Power Plants, subclasses 700+ for synchronizing of plural motors and see (2) Note in this class (416), subclass 120.

318, Electricity: Motive Power Systems, subclasses 41+ and 85 for synchronizing electric motors, and see (2) Note in subclass 120 of this class (416).

361, Electricity: Electrical Systems and Devices, subclasses 243+ and a synchronization of rotary shafts, and see (2) Note in subclass 120 of this class (416).

370, Multiplex Communications, subclasses 304+ for multiplex systems which include rotary distributors with means for synchronizing them.

375, Pulse or Digital Communications, subclasses 354+ for synchronizing the operation of a receiving and transmitting mechanisms.

**35** This subclass is indented under subclass 31. Apparatus comprising means to manually select and fix a desired operating condition or characteristic or other state from which there should be no variation and an electrical system including (1) means to receive signals based on the desired and the actual condition, characteristic or state, respectively and to relate the signals to one another and (2) means to control the apparatus to reduce the variation between the actual and the desired state.

(1) Note. Included under this definition of "electrical" are the well known electron devices, such as vacuum tubes, transistors, semi-conductors, etc.

SEE OR SEARCH THIS CLASS, SUBCLASS:

30, for an apparatus comprising a drive motor and an impeller driven, thereby, interrelated controls for adjusting impeller pitch and drive motor throttle and an electrical system for sensing a condition or for actuating the controls.

**36** This subclass is indented under subclass 31. Apparatus wherein operation of the control means for the apparatus part is caused or permitted in response to means which sense two different conditions.

(1) Note. Examples of different conditions for this subclass are temperature, shaft speed, vehicle speed, etc.

- (2) Note. The sensing means need be nothing more than a single element capable of responding to plural diverse conditions.
- (3) Note. One control means may modify or control another control means.
- 37** This subclass is indented under subclass 36. Apparatus in which one condition sensed is a characteristic of the surrounding atmosphere.
- (1) Note. Relative air speed is considered to be wind force; altitude is considered to be characteristic of atmospheric density. Both of these conditions are included under this definition.
- 38** This subclass is indented under subclass 36. Apparatus comprising a motor driving the impeller and in which one condition sensed is an operating characteristic of the motor, but not including rotational speed or torque developed by the motor shaft.
- (1) Note. A typical condition sensed for this subclass is manifold pressure, exhaust temperature or rate of consumption of fuel or working fluid for the motor.
- 39** This subclass is indented under subclass 31. Apparatus wherein the control means is actuated in response to means which senses (1) a temperature state or variation or (2) an accumulation of ice which adversely affects operation of the apparatus.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 38, for an apparatus having automatic control in response to a plurality of conditions and in which one condition is temperature of a drive engine part or of the ambient atmosphere.
- 40** This subclass is indented under subclass 31. Apparatus wherein the control means is operated in response to a means which senses the speed of the working fluid\* relative to the apparatus.
- (1) Note. The relative working fluid speed may be the measure of an impeller support (e.g., vehicle) movement through the medium, as commonly determined by a Pitot tube, or may be any other measurement of the relative working fluid flow either upstream or downstream of the impeller apparatus.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 37, for a device comprising automatic control in response to plural condition sensing and in which one of the conditions is relative working fluid flow velocity, (relative air speed of the vehicle, or wind force).
- 41** This subclass is indented under subclass 40. Apparatus wherein the working fluid comprises natural fluid current.
- (1) Note. By “natural fluid current” is meant the flow of fluid due to atmospheric conditions or to normal water currents. The flow of generated fluid (e.g., fan or blower forced), or of fluid past a moving body is not considered to be “natural fluid current” under this definition and devices having control means responsive to such flow will be found in the preceding subclass.
- 42** This subclass is indented under subclass 31. Apparatus wherein the control means is caused to operate in response to a means which senses (1) a condition of fluid pressure variation within the apparatus or the ambient or (2) the elevation of the apparatus relative to sea-level or ground-level.
- 43** This subclass is indented under subclass 31. Apparatus wherein the control means is caused to operate in response to a force acting on the apparatus or a part thereof which is sensed as the resistance to a rate or directional movement variation of the apparatus or part.
- 44** This subclass is indented under subclass 31. Apparatus comprising a rotating impeller\* and control means which is caused to operate in response to a condition proportional to the rotational speed of the impeller.

- 45** This subclass is indented under subclass 44. Apparatus wherein the means which initiates the control operation comprises a valve member which is mounted so as to rotate about an axis and assume various positions directly in accordance with the rate of rotation, the control being initiated when the valve member reaches a predetermined position.
- 46** This subclass is indented under subclass 44. Apparatus wherein the apparatus includes means for retaining the impeller or working member in a selected position of adjustment.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 140, for a mere centrifugally actuated stop means for preventing droop beyond a predetermined point of a resiliently mounted, articulated or self-shifting impeller, in the absence of automatic control means under the definition of this subclass 44.
- 47** This subclass is indented under subclass 44. Apparatus wherein the control means which acts on the apparatus part comprises a motor solely for that purpose actuable by the means responsive to the impeller rotation speed.
- (1) Note. A motor for this subclass does not include a mere spring or weight device but must comprise an energy conversion means such as a hydraulic, pneumatic or electric motor.
- 48** This subclass is indented under subclass 47. Apparatus wherein the motor is carried by and rotates with the impeller\*.
- (1) Note. The motor may be carried by the working member\*, the carrier\* for the working member, the impeller shaft or any other part so closely associated with the impeller as to partake of the working member movement.
- 49** This subclass is indented under subclass 44. Apparatus including means actuated by a human attendant to (1) return the control system to a datum point or (2) override or prevent operation of the control system.
- 50** This subclass is indented under subclass 49. Apparatus wherein the means which initiates the control operation comprises a mass mounted so as to rotate about an axis and assume various radial positions in accordance with the rate of rotation, the control being initiated when the mass reaches a predetermined position.
- 51** This subclass is indented under subclass 44. Apparatus comprising a weight which rotates at a speed proportional to that of the impeller and moves towards and away from its axis of rotation in a straight line or is directed along a predetermined path by some means other than a pivoted mounting.
- 52** This subclass is indented under subclass 44. Apparatus wherein the control means which acts on the apparatus part comprises a mass which is caused to rotate in a varying radius dependent upon the speed of rotation about an axis coincident with the rotation axis of the shaft which supports and drives or is driven by the impeller.
- 53** This subclass is indented under subclass 52. Apparatus wherein the rotating mass is pivoted on an axis parallel to that of the axis of rotation of the impeller.
- 54** This subclass is indented under the class definition. Apparatus wherein an impeller\* is mounted on or proximate an "art device" and is powered by the relative motion of the device or parts thereof, the device being of special construction or adaptation to perform a particular function other than that directly related to the support or operation of the class subject matter.
- (1) Note. Patents in which more of the "art device" is claimed than is necessary to operate the impeller do not come within this definition, being properly classifiable with the art device, except in those cases in which there is no other suitable classification and the claim would be classifiable in subclass 146 as a "combined" apparatus in the absence of this or other pertinent superior subclass.
- (2) Note. A particular object may or may not be an "art device" for this subclass

dependent upon the impeller relationship therewith. For example, a vehicle may be an “art device” under the subclass definition when an attached impeller is arranged merely to cool the occupant but would not be so considered when arranged to propel the vehicle or to perform an essential function on some part thereof, as to cool the engine.

**SEE OR SEARCH THIS CLASS, SUB-CLASS:**

146+, for the combination of an impeller with an “art device” not involving operation of the impeller by the device and see (1) Note above for a general statement of the line with other classes.

**55** This subclass is indented under subclass 54. Apparatus wherein the “art device” comprises a vehicle or like device.

**56** This subclass is indented under subclass 54. Apparatus wherein the device comprises a contrivance which rocks upon a supporting runner, as a cradle or rocking chair.

**SEE OR SEARCH CLASS:**

297, Chairs and Seats, subclass 180.16 for a seat with means heating or refrigerating the seat or its occupant, said means being more than the mere attachment of a fan to an ordinary chair.

**[57.**

This subclass is indented under subclass 56. Apparatus wherein rocking of the device effects motion of an inertial mass which in turn transmits a drive motion to the impeller.

**58** This subclass is indented under subclass 56. Apparatus wherein rocking of the device effects an uninterrupted, unidirectional, rotary movement of the impeller.

**59** This subclass is indented under subclass 54. Apparatus wherein the device comprises a contrivance which swings about a supporting pivot, as a door or hammock.

(1) Note. This definition does not include a swinging member which is merely a part

of an “art device”, such as a sewing machine treadle.

**60** This subclass is indented under subclass 54. Apparatus wherein the impeller is adapted to be directly attached to, or may be formed as an integral part of, a rotary device such that rotation of the device effects impeller operation.

**61** This subclass is indented under the class definition. Apparatus comprising means to perform quantity or condition measurements or observations so as to determine operating or structural characteristics of the apparatus or extent of motion or movement of some part thereof, including means of a visual or audible nature, (other than fixed exhibitors, e.g., signs) which give information about or permit viewing of (e.g., inspection window) a condition of the apparatus.

**62** This subclass is indented under the class definition. Apparatus wherein a working member\* fluid reaction surface has supplementary means detachably mounted thereon, the working member being intended for operation with or without the supplementary means as a matter of choice.

**63** This subclass is indented under the class definition. Apparatus comprising (1) wheels, skids or other special means to facilitate movement of the apparatus, (2) means which specifically adapts the apparatus to be supported on some part of a human body or an animal or (3) hand or body engaging means to facilitate carrying of the apparatus.

(1) Note. The movement facilitating means for this definition must be for the purpose of facilitating movement other than that which is essential for the device to operate as an impeller and does not include vehicular structure when the impeller\* comprises or is ancillary to the motive means thereof, classification in such instance being in the proper vehicle class.

(2) Note. This definition is not intended to include a handle disclosed solely to facilitate support of the apparatus during operation. The carrying function should

be specifically disclosed for classification here as an original.

**64** This subclass is indented under the class definition. Apparatus wherein a working member\* moves in a straight line path as a proximate result of, or to directly effect, reaction between the member and the working fluid\*.

(1) Note. Included under this definition is a working member which undergoes other movements (e.g., rotary) concurrently with the straight line reaction motion.

(2) Note. The straight-line movement for this definition must be that which is the immediate cause or effect of the fluid reaction and does not include mere adjustment (e.g., feathering) or support movement (e.g., vehicular).

**65** This subclass is indented under subclass 64. Apparatus wherein (1) the working member rotates about an axis simultaneously with the straight-line movement thereof, each movement being a proximate result of, or directly effecting, reaction between the member and the working fluid or (2) the apparatus includes a rotary working member distinct from and operative in conjunction with that member which moves in a straight line path.

(1) Note. Included under this definition is rotary movement (other than for mere adjustment or of support) extending through less than 360° (e.g., oscillatory).

**66** This subclass is indented under subclass 64. Apparatus wherein (1) the working member comprises pliable or elastic material so that it flexes during operation of the apparatus or (2) the working member or some portion thereof moves relative to the member support or other member portion during operation of the apparatus.

**67** This subclass is indented under subclass 66. Apparatus wherein the movement of the working member or parts thereof are such to permit flow of working fluid through a defined aperture under predetermined operating conditions and to close off such through flow during other operating conditions.

**68** This subclass is indented under subclass 66. Apparatus wherein the working member comprises a plurality of surfaces which pivotally move to or from one another in a related manner to form a unitary device wherein the various surfaces have a similar working fluid reactive function.

**69** This subclass is indented under the class definition. Apparatus comprising an impeller\* which is hand powered and at least partially hand supported by the operator thereof.

(1) Note. For this definition, hand powered or hand supported includes an arm or fingers.

SEE OR SEARCH THIS CLASS, SUBCLASS:

64+, for similar devices wherein the working member reaction motion is along a straight line path.

**70** This subclass is indented under subclass 69. Apparatus wherein the impeller is disclosed as being of the type held in and moved directly by motion of a user's hand to cause motion of a fluid.

SEE OR SEARCH THIS CLASS, SUBCLASS:

63, for apparatus comprising a means which specifically adapts the apparatus to be supported on some part of a human body or an animal.

SEE OR SEARCH CLASS:

30, Cutlery, subclasses 322+ and 324+ for tools of the fork or spoon type designed for the purpose of handling food.

**71** This subclass is indented under subclass 70. Apparatus wherein the device (1) is so constructed as to resemble some object or being, (2) has writing or similar distinctive marking thereon, (3) has decorative embellishments associated therewith or (4) is combined with features other than impeller structure, supporting or attaching means therefor or impeller driving or driven means.

- (1) Note. For a more complete definition of a “combined” feature see notes under subclass 146.
- 72** This subclass is indented under subclass 70. Apparatus in which major portions of the impeller are movable with respect to each other while remaining connected.
- (1) Note. This definition does not include a mere indiscriminately flexible member.
- 73** This subclass is indented under subclass 72. Apparatus comprising a working member foldable into a more compact form by angular movement of different portions thereof about a common pivot normal to the member work surface.
- 74** This subclass is indented under subclass 69. Apparatus wherein the impeller is (1) caused to follow a predetermined path or operation by relatively fixed guide means or (2) supported for movement about a pivot in the manner of an oar.
- (1) Note. A claim to mere subcombination structure disclosed for use in supporting or connecting an oar in operative relation to a boat and not involving oar construction, blade features or feathering means is classified in subclasses 101+ of Class 440, Marine Propulsion.
- (2) Note. Classification of a claim to an oar is in Class 440, Marine Propulsion, regardless of impeller detail claimed, if specific boat structure or relationship is claimed and see the Class Definition of this Class 416 and notes thereunder for a general statement of the line.
- 75** This subclass is indented under subclass 69. Apparatus wherein motion to the impeller is effected by imparting a reciprocatory motion to either component of a pin-slot connection.
- 76** This subclass is indented under subclass 69. Apparatus wherein motion is transmitted to the impeller by means of a manually operated crank handle.
- 77** This subclass is indented under subclass 76. Apparatus wherein at least two working members are so supported that during operation of the apparatus the moving members describe intersecting or overlapping paths.
- 78** This subclass is indented under the class definition. Apparatus wherein a working member\* or a rigid extension thereof is pivotally connected to a crank portion of a rotary shaft or a mechanical equivalent thereof and so guided or supported that the member has a motion resembling that of a conventional hand manipulated canoe paddle, sculling oar, rowing oar or stirring member.
- SEE OR SEARCH CLASS:  
440, Marine Propulsion, subclasses 26+ for a marine vessel having crank paddle propulsion means and see Class 416, Class Definition, for a general statement of the line.
- 79** This subclass is indented under the class definition. Apparatus wherein a working member\* moves back and forth about an axis, or in an orbit, with an arc of movement of not more than 360°, the movement occurring as a proximate result of, or to directly effect, reaction between the member and the working fluid\*.
- (1) Note. Included under this definition is a working member which undergoes other movements (e.g., rotary) concurrently with the oscillatory reaction motion, the resultant working member motion generally being undulatory or wave-like.
- (2) Note. The oscillatory movement for this definition must be that which is the immediate cause or effect of the fluid reaction and does not include mere adjustment (e.g., feathering) or support motion.
- 80** This subclass is indented under subclass 79. Apparatus comprising a weight arranged relative to the working member and acting as (1) a swinging member to regulate the motion of the working member or the drive motor (e.g., clock), (2) a mass to counterbalance the mass of the working member or (3) an inertia mass or flywheel to smooth out the oscillatory

- motion of the working member and permit it to continue its motion even after removal of the drive means.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 19, for an impeller consisting of a single working member and a weight positioned to counterbalance the mass of the working member.
- 81** This subclass is indented under subclass 79. Apparatus wherein the working member comprises pliant material.
- 82** This subclass is indented under subclass 79. Apparatus wherein the working member comprises a plurality of sections which move relative to one another.
- 83** This subclass is indented under subclass 79. Apparatus wherein the oscillatory working member concurrently undergoes some other diverse motion during the member operation.
- (1) Note. The additional motion may be somewhat distinct from the oscillatory motion such as cyclic feathering, or may be integral therewith such as continuous rotation concurrently with oscillation to produce a resultant wave-like motion.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:  
 78, for a working member which oscillates in an elliptical path.
- 84** This subclass is indented under the class definition. Apparatus wherein a working member\* (1) is itself so constructed as to float in or on a working fluid or (2) has collapsible walls expandable to an operative shape by filling with a fluent material.
- SEE OR SEARCH CLASS:  
 60, Power Plants, subclasses 495+ for motors having a buoyant working member motivated by the vertical rise and fall of the surface of a body of fluid.  
 440, Marine Propulsion, subclasses 98+ for a marine vessel having a buoyant propeller.
- 85** This subclass is indented under the class definition. Apparatus wherein an impeller\* is supported in a working fluid by buoyant means.
- SEE OR SEARCH CLASS:  
 60, Power Plants, subclasses 495+ for motors having a buoyant working member motivated by the vertical rise and fall of the surface of a body of fluid.
- 86** This subclass is indented under subclass 85. Apparatus wherein the buoyant support means comprises a hub or peripheral annulus to which the impeller working members are directly attached.
- SEE OR SEARCH CLASS:  
 440, Marine Propulsion, subclasses 98+ for a marine vessel having a buoyant propelling device.
- 87** This subclass is indented under the class definition. Apparatus comprising a rotating working member\* and wherein the working member dimension normal to the rotation axis may be lengthened or shortened to change the effective operative diameter of the apparatus.
- (1) Note. This subclass does not include mere cyclic radial movement of a working member wherein the overall diameter of the impeller remains unchanged.
- 88** This subclass is indented under subclass 87. Apparatus wherein (1) the working member surface area or configuration is alterable, as by collapsing or by telescoping parts, or (2) the working member is attached to a carrier or support solely by means which cannot sustain the member in a fixed position.
- 89** This subclass is indented under subclass 87. Apparatus wherein the blade angle\* of the working member may be selectively varied.
- 90** This subclass is indented under the class definition. Apparatus comprising a working member\* including conduit means for conducting a flow of fluid therethrough and wherein either the inlet or outlet to the flow conducting means is on the working member for the intake or dis-

charge of fluid directly to or from the working fluid\*.

- (1) Note. Impellers having means for modifying the aerodynamic action of the blades thereof by giving motion to the layer of fluid in contact with the blades by an intake or discharge of fluid adjacent the layer (i.e., boundary layer excitation) are here classified.
  - (2) Note. A mere apertured, looped or foraminous working member wherein the medium fluid flows substantially uninterruptedly through the member is not included under this definition, being properly classifiable in subclasses 227+ or 231 below.
- 91** This subclass is indented under subclass 90. Apparatus wherein both the inlet and outlet to the passage are open to the working fluid, the flow within the passage comprised, at least in part, of working fluid.
- 92** This subclass is indented under subclass 90. Apparatus wherein the working member is supported for rotation on a shaft and the entire fluid flow out of the member conduit is at the periphery in a direction substantially perpendicular to the axis of rotation.
- 93** This subclass is indented under the class definition. Apparatus wherein either a portion of the working fluid\* encompassing the impeller\* or the exhaust gas from an impeller\* drive engine is caused to flow through (1) the impeller hub, (2) drag or head resistance reducing means such as a smooth outline member or covering supported on the impeller carrier\* or (3) an enclosing cover for an apparatus part, such as a drive motor or transmission.
- 94** This subclass is indented under subclass 93. Apparatus wherein the working fluid or exhaust gas is caused to flow through an aircraft spinner or cowling.
- 95** This subclass is indented under the class definition. Apparatus having means associated therewith (1) to heat or cool the apparatus or working fluid\* or to minimize the transfer of heat thereto or therefrom by shielding or structural arrangement.
- (1) Note. Insofar as many arrangements, structures and materials inherently function to heat, cool or insulate, the patent must disclose heating, cooling or insulation as a function of the claimed subject matter for classification in this subclass.
- 96** This subclass is indented under subclass 95. Apparatus comprising a working member\* or carrier\* having (1) a chamber therein containing a material which is capable of changing its physical state from or to a solid, liquid, or gas, thereby transferring heat between itself and the working member or carrier or (2) passage means therein through which a heat exchange fluid is caused to flow.
- 97** This subclass is indented under subclass 96. Apparatus wherein the heat exchange fluid (1) comprises working fluid\* directed into the flow passage or (2) is exhausted into the working fluid.
- 98** This subclass is indented under the class definition. Apparatus comprising a working member\* which rotates about a "fixed" axis and undergoes at least one different and distinct movement concurrently with the rotary motion.
- (1) Note. The different movements for purposes of this subclass may be any combination of differing types, as rotary and oscillating, the same type movement about different axes, as plural rotary.
  - (2) Note. One of the movements may be of the unitary device such as a rotary fan supported\* for oscillation, however, movement of an art device with which an impeller\* may be combined does not comprise one of the motions for this subclass where such motion is incidental to, or the resultant of, impeller operation such as the motion of an impeller powered vehicle.
  - (3) Note. An axis is considered "fixed" even though it may be movable for purpose of adjustment or support on a movable art device such as a vehicle.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 63, for an impeller guided along a track-way or cable.
- 131+, for an articulated working member or shiftable impeller movable during operation in response to dynamic forces exerted thereon.
- 147+, for manual or noncyclic means for adjusting an impeller or working member.
- 99** This subclass is indented under subclass 98. Apparatus comprising a working member supported\* for rotation about a shaft carried by another rotating working member.
- 100** This subclass is indented under subclass 98. Apparatus comprising an impeller supported for rotation about an axis and wherein the support structure comprising the rotation axis is caused to partake of a continuous angular oscillating movement across the rotation axis concurrently with the impeller rotatory motion.
- 101** This subclass is indented under subclass 98. Apparatus wherein the rotary working member is supported or guided to move radially inward or outward with respect to the fixed rotation axis to assume a particular operative position at a predetermined point in each rotation cycle.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 87, for a radially extensible or retractable working member wherein the effective operative diameter of the apparatus is changed.
- 102** This subclass is indented under subclass 98. Apparatus wherein the rotary member is supported for movement relative to the fixed rotation axis to assume a particular operative position at a predetermined point in each rotation cycle in response to tilting or inclining of the carrier\*, as a unit, relative to the fixed rotation axis of the apparatus.
- 103** This subclass is indented under subclass 98. Apparatus comprising an impeller\* of the type having one or more bladed working members which project radially outward from a rotation axis, such as a helicopter rotor, the inner radial end of each working member being pivotally attached to a carrier\* for movement about an axis parallel to the rotation axis such that the member oscillates forwardly (in the direction of rotation) during a portion of the rotation cycle (lead) and oscillated rearwardly (opposite the direction of rotation) during another portion of the rotation cycle (lag).
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
- 141, for "free blade" mountings not involving means for causing cyclic blade movement.
- 104** This subclass is indented under subclass 103. Apparatus wherein the lead-lag movement of the blade effects or is effected by additional movement, e.g., change of pitch, of the same or another blade.
- 105** This subclass is indented under subclass 103. Apparatus comprising mechanism for moving the blade about the lead-lag axis.
- 106** This subclass is indented under subclass 103. Apparatus provided with means to limit the extent or reduce the frequency of blade movement about the lead-lag axis.
- 107** This subclass is indented under subclass 106. Apparatus wherein the movement restraining means is of the resilient biasing or limit stop type.
- 108** This subclass is indented under subclass 98. Apparatus wherein the concurrent movement is effected by an actuating means which is caused to follow an orbital path of varying radius about the rotation axis of the working member.
- 109** This subclass is indented under subclass 108. Apparatus wherein the eccentric actuating means comprises a guide surface or track which is fixedly eccentrically supported relative to the rotatable working member.
- 110** This subclass is indented under subclass 98. Apparatus wherein the working member simultaneously and uninterruptedly rotates about two or more different axes.

- 111** This subclass is indented under subclass 110. Apparatus wherein the different axes are parallel to one another.
- 112** This subclass is indented under subclass 98. Apparatus wherein the concurrent movement is effected in response to engagement of the rotating working member, or means connected thereto, with a stationary guide means or a static obstruction in the path of movement.
- 113** This subclass is indented under subclass 112. Apparatus wherein the movement effecting means includes a surface axially inclined with respect to the impeller rotation axis (e.g., a helical cam).
- 114** This subclass is indented under subclass 113. Apparatus wherein the axially inclined surface is movable at will by a human attendant to various positions to change the concurrent movement of the working member.
- 115** This subclass is indented under subclass 114. Apparatus in which the concurrent movements of a plurality of impellers are varied at will.
- 116** This subclass is indented under subclass 112. Apparatus wherein the movement effecting means comprises a cam track or guide surface fixedly supported relative to the impeller rotation axis.
- 117** This subclass is indented under subclass 98. Apparatus wherein the working member concurrent movement occurs in response to the force of gravity or the working fluid acting on the working member or apparatus part directly connected thereto.
- 118** This subclass is indented under subclass 117. Apparatus including means actuated by a human attendant to modify or affect the operation of the apparatus.
- 119** This subclass is indented under subclass 117. Apparatus wherein the rotational movement and the concurrent movement are each about axes parallel to one another.
- 120** This subclass is indented under the class definition. Apparatus comprising two impellers\* which are independently supported\* or which move relative to one another during use.
- (1) Note. Movement of one impeller relative to another comprises (1) different impelling movement (e.g., rotation in the opposite direction, in the same direction at variable speeds, or positive drive of one and free rotation of another), (2) relative pitch\* adjustment, or (3) moving one impeller closer to or away from another impeller by means other than mere adjustment of securing means for the impeller.
- (2) Note. Synchronizing means for a plurality of motors driving individual impellers is in Class 318, Electricity: Motive Power Systems, subclasses 41+ where the motors have synchronizing interconnections, and subclass 85 where the motors have a synchronizing or phasing control; a synchronizer for plurality of shafts is in 361, Electricity: Electrical Systems and Devices, subclasses 243+ and a synchronizer for a plurality of non-electrical motors is in Class 60, Power Plants, subclasses 700+.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 33+, for apparatus having plural distinct impellers with an interrelated control actuated by (1) means sensing a non-cyclic condition, (2) centrifugal force, or (3) torque or thrust.
- 198+, for plural impellers which are axially spaced on the same support\* and which are not relatively movable.
- SEE OR SEARCH CLASS:
- 60, Power Plants, subclasses 700+ for synchronizing of plural motors, and see (2) Note above.
- 74, Machine Element or Mechanism, subclasses 640+ for gearing with impellers recited by name only, and subclasses 665+ for gear mechanisms for driving a plurality of impellers from a single driving means, and see (2) Note above.

- 244, Aeronautics, subclass 17.23 for plural gyroplane rotors combined with significant vehicle structure; subclass 55 for the arrangement of two or more power plants on an aircraft where more structure than that is necessary to mount the power plants is claimed; and subclass 65, for two or more impellers mounted on an aircraft where more structure than that necessary to mount the impellers is claimed.
- 318, Electricity: Motive Power Systems, subclasses 41+ and 85, and see (2) Note above.
- 361, Electricity: Electrical Systems and Devices, subclasses 243+ for electrical synchronizers for rotary shafts and see (2) Note above.
- 440, Marine Propulsion, subclasses 79+ for ships having multiple screw propellers.
- 475, Planetary Gear Transmission Systems or Components, appropriate subclasses, for planetary gearing to drive plural load devices.
- 121** This subclass is indented under subclass 120. Apparatus wherein the support for at least one of the impellers is movable as a whole to a different operative position relative to (1) at least one other impeller or (2) a common support for the plural impellers (e.g., vehicle body).
- (1) Note. The movement does not include that relative movement of a support which is inseparable from normal impeller operation (e.g., reciprocating or eccentric shaft), nor is a mere mounting adjustment or tiltable carrier\* included.
- 122** This subclass is indented under subclass 120. Apparatus wherein the impellers are so supported that during operation the moving members describe intersecting or alternately overlapping paths.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 77, for working members having similar paths of operation and wherein the impeller is operator supported and manually actuated.
- 123** This subclass is indented under subclass 120. Apparatus in which the impellers have a common support and rotate about axes which are angular on skew to one another.
- SEE OR SEARCH CLASS:
- 244, Aeronautics, subclasses 17.11+, and particularly subclass 17.21 for plural impellers having divergent axes and combined with significant aircraft structure.
- 124** This subclass is indented under subclass 120. Apparatus wherein the plural impellers are supported for rotation about a common axis.
- 125** This subclass is indented under subclass 124. Apparatus wherein the impellers are each driven by a separate power sources.
- 126** This subclass is indented under subclass 124. Apparatus wherein the coaxial impellers rotate one inward of the other on the same radial plane.
- 127** This subclass is indented under subclass 124. Apparatus in which the coaxial impellers are arranged to be adjusted simultaneously by positive means.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 128+, for oppositely rotating "free blade" impellers in which an adjustment caused by aerodynamic forces may or may not be simultaneous.
- 128** This subclass is indented under subclass 124. Apparatus in which the direction of rotation of one of the impellers is contrary to the direction of rotation of another impeller supported coaxially therewith.
- (1) Note. In this subclass may be found two oppositely rotating coaxial impellers adjustable only by the dynamic blade forces thereon, e.g., "free blade" type.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 76+, for oppositely rotating coaxial impellers which are operator supported and manually actuated.

- 127, for oppositely rotating impellers concurrently adjusted by positive means.
- 129** This subclass is indented under subclass 128. Apparatus comprising a source of mechanical power rotating the plural impellers.
- 130** This subclass is indented under subclass 120. Apparatus wherein one impeller is adjusted unequally or separately with respect to another.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 127, for plural impellers having coaxial axes of rotation and comprising means for adjusting the impellers concurrently, but which may be a differential adjustment.
- 131** This subclass is indented under the class definition. Apparatus comprising an impeller\* or working member\*, or a part thereof mounted (1) on a support by means of a joint or a yielding or elastic connection or (2) as to be capable of self movement due to the effect of dynamic forces thereon (e.g., rotary motion or working fluid\*).
- (1) Note. Mere working member composition of flexible material is not included; however, a flexible joint or connection permitting articulation or "controlled", shifting of a working member or part is included.
- (2) Note. This definition does not include mere direct movement between an operative and inoperative position of an impeller or working member.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 87+, for a working member which moves radially outward relative to its rotation axis in response to dynamic forces exerted directly thereon.
- 132** This subclass is indented under subclass 131. Apparatus wherein the working member comprises (1) a plurality of relatively movable surfaces (2) a plurality of separate or divergent surfaces which react with the working fluid sequentially or (3) a surface which is nonself-supporting, such as a sail.
- 133** This subclass is indented under subclass 131. Apparatus in which a working member carrier\* supported on a rotary drive shaft is axially movable relative to said shaft in response to dynamic forces exerted on the member.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 161, for a shaft supported carrier axially displaceable by manual or power actuating means.
- 134** This subclass is indented under subclass 131. Apparatus wherein the impeller or working member is connected to the support means by a nonmetallic elastic element.
- 135** This subclass is indented under subclass 131. Apparatus wherein the impeller or working member movement is resisted by a resilient element which tends to restore the impeller or member to an original or predetermined position.
- 136** This subclass is indented under subclass 135. Apparatus comprising a working member supported for rotation and movable only about a radial axis in response to dynamic forces.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 89, for an impeller comprising a rotary working member pivotable about its radial axis concurrently with a radial inward or outward movement of the member whereby the effective operative diameter of the impeller is increased or decreased.
- 137** This subclass is indented under subclass 136. Apparatus wherein the resilient element comprises a spiral spring coaxial with the impeller shaft.
- 138** This subclass is indented under subclass 135. Apparatus wherein the device includes mechanism whereby an operator may regulate the operation thereof.
- 139** This subclass is indented under subclass 131. Apparatus wherein the impeller or working member movement is either aided or resisted

- by a weight other than the impeller or working member itself.
- 140** This subclass is indented under subclass 131. Apparatus wherein means is provided to limit the extent or reduce the frequency of the impeller or working member movement.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 106+, for a rotor of the lead-lag type provided with movement restraining means.
- 141** This subclass is indented under subclass 131. Apparatus wherein the impeller or working member is supported for movement about plural pivots or for universal movement about one pivot.
- (1) Note. Impellers having a ball and socket mounting enabling the impeller to pivot about any axis of the mounting are included in this subclass.
- 142** This subclass is indented under the class definition. Apparatus wherein an impeller\* is adapted to assume a more compact form by folding, pivoting, collapsing or similar movement of a working member\* so as to render the member inoperative or to facilitate storage.
- (1) Note. This definition does not include a mere adjustable (e.g., feathering) working member wherein the inoperative position is no more than the terminal position of a plurality or range of operative positions.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 85+, for an impeller selectively moveable to or from an operative position relative to a float support.  
 87+, for a rotating impeller which is adapted to assume a more compact form by shortening the effective operative diameter of the apparatus.
- 143** This subclass is indented under subclass 142. Apparatus comprising a rotary impeller wherein the folding, pivoting, collapsing or similar movement occurs in the plane of rotation.
- 144** This subclass is indented under the class definition. Apparatus comprising a working member\* and arranged, or formed, having means to prevent or preclude imbalance thereof due to uneven mass distribution.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
 80, for a working member mounted for oscillatory motion and provided with a weight mass which acts as a pendulum, a counterbalance or an inertial mass.
- 145** This subclass is indented under subclass 144. Apparatus in which the means comprises a mass of matter in any state and mounted so as to (1) move and assume various positions dependent on the rotation of the impeller, without the intervention of a human attendant or (2) be moved at will by a human attendant to various positions.
- 146** This subclass is indented under the class definition. Apparatus (1) claimed in combination with features other than impeller structure, supporting or attaching means therefor or impeller driving or driven means and not provided for in preceding subclasses or (2) having means or parts capable of structural rearrangement or modification to selectively provide either an impeller organization having some other mode of operation or a device of some other description.
- (1) Note. Included in this definition as impeller driving or driven means includes transmission clutch or brake means insofar as such apparatus is part of the driving or driven means.
- (2) Note. Examples of a combined feature are: a programmer, a timer, or check controlled apparatus to control operation, or a cleaner for the working member. An example of a convertible feature is an oar which is relocated or rearranged to act as a sail or a mast.
- (3) Note. Excluded as combined features under this definition are the necessary appurtenances for any relatively moving

surfaces (e.g., lubricating, sealing, bearing or packing elements, etc.).

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 54+, for the combination of an impeller with an “art device” wherein the device causes operation of the impeller.
- 62, for a device comprising an attachment attachable and detachable to the working surface, but which does not result in a “convertible” feature, i.e., does not result in a different mode of operation or in a device of some other description.
- 147** This subclass is indented under the class definition. Apparatus comprising mechanism for moving an impeller\* or working member\* relative to a carrier\* or support\* means therefor in response to motor or manual actuation, such movement being other than that occurring as a proximate result of, or to directly effect, reaction between the impeller or working member and the medium fluid.
- (1) Note. The term “impeller” comprises a working member and any parts rigidly connected therewith, such as a hub or drive shaft. For a more comprehensive definition, see the Glossary, Main Class Definition.
- (2) Note. Excluded under this definition is a mere limit stop or lock adjustment which may only indirectly result in impeller adjustment.
- 148** This subclass is indented under subclass 147. Apparatus wherein the impeller carrier is caused to pivot a unit relative to a supporting shaft.
- 149** This subclass is indented under subclass 147. Apparatus wherein the impeller together with the carrier\* and support means therefor is shiftable as a unit relative to a supporting surface or device.
- 150** This subclass is indented under subclass 149. Apparatus in which the shiftable carrier support moves along a straight line.

**151** This subclass is indented under subclass 47. Apparatus wherein the impeller or working member movement is effected by power from a shaft which directly drives or is driven by the impeller.

**152** This subclass is indented under subclass 151. Apparatus wherein the impeller or working member movement is effected in response to operation of an element which either removes or applies a force resisting movement of an apparatus part.

- (1) Note. Included under this definition is an impeller provided with a differential means between the adjusting means and the drive shaft and provided with brake means to cause relative rotation of the differential means.

**153** This subclass is indented under subclass 147. Apparatus wherein the apparatus includes means for retaining the impeller or working member in a selected position of adjustment.

- (1) Note. The retaining means must be more than or in addition to a mere static condition of the positioning mechanism. For example, a pivoted hand lever is excluded, but a detent thereon is included under this definition.
- (2) Note. Excluded under this definition is a limit stop which shuts off the motor when a predetermined position of impeller adjustment is reached.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

46, for means to retain the impeller or working member in a selected position of adjustment combined with control means responsive to impeller speed.

**154** This subclass is indented under subclass 153. Apparatus in which the mechanism for moving the impeller or working member comprises a fluid motor.

- 155** This subclass is indented under subclass 147. Apparatus wherein the impeller or working member movement is effected by a motor mounted on and rotatable with the impeller\*.
- 156** This subclass is indented under subclass 155. Apparatus wherein the motor is driven by fluid.
- 157** This subclass is indented under subclass 156. Apparatus wherein the fluid motor is coaxial with the axis of the impeller shaft and is rigidly connected therewith.
- 158** This subclass is indented under subclass 156. Apparatus wherein the fluid motor is mounted on or within the working member.
- 159** This subclass is indented under subclass 147. Apparatus wherein the impeller or working member movement is effected by a power or manual actuator mounted on a part which is fixed in position relative to the impeller or working member.
- 160** This subclass is indented under subclass 159. Apparatus comprising planetary gearing between an impeller adjusting element movable with the impeller and a part which is fixed in position relative to the impeller, which part controls the movement.
- 161** This subclass is indented under subclass 159. Apparatus wherein the power or manual actuator effects an axial movement of the impeller as a unit relative to a supporting shaft which directly drives or is driven by the impeller.
- 162** This subclass is indented under subclass 159. Apparatus wherein the mechanism for moving the impeller or working member is actuated by a motor.
- 163** This subclass is indented under subclass 159. Apparatus wherein the moving mechanism comprises a rod extending through the entire length of a shaft which directly drives or is driven by the impeller.
- 164** This subclass is indented under subclass 159. Apparatus comprising a sleeve, collar or rod on or in a shaft which directly drives or is driven by the impeller and is reciprocated relative thereto to effect the movement.
- 165** This subclass is indented under subclass 164. Apparatus wherein the sleeve, collar or rod is reciprocated by a screw which is coaxial with the shaft.
- 166** This subclass is indented under subclass 164. Apparatus wherein the adjusting movement is effected, at least in part, by a rack-pinion connection intermediate the reciprocating member and the working member.
- (1) Note. The reciprocating member may comprise either component of the rack-pinion connection.
- 167** This subclass is indented under subclass 164. Apparatus comprising a pin-slot, cam-slot or cam connecting means between the reciprocating member and the movable working member.
- 168** This subclass is indented under subclass 164. Apparatus comprising link connecting means between the reciprocating means and the movable working member.
- (1) Note. A mere crank arm extending between the working member and the reciprocating member, being rigidly attached at one end and pivotally connected at the opposite end, is not included by this definition, classification being in subclass 164 above.
- 169** This subclass is indented under the class definition. Apparatus comprising means which selectively (1) engages the impeller\* with a driving or driven mechanism or (2) retards or stops rotary motion of the impeller\*.
- 170** This subclass is indented under the class definition. Apparatus wherein the claimed subject matter includes, by more than name only, (1) prime mover means for driving the impeller\* or (2) driving or driven mechanism to or from the impeller\*.
- (1) Note. Included under this definition is an articulated driving shaft, details of an engine or motor, etc., a member clearly recited as a crank or pedal to be actuated by an operator's hand or foot. The recited details of the motor or engine must be such as to identify the prime

mover; mere naming of the prime mover as an internal combustion engine, turbine, electric motor, etc., is not sufficient to cause classification herein.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 3, for motion caused by direct response of the working member or impeller to an electrical or magnetic field or effect.
- 120, especially subclass 128 for specific transmission means between an engine and a plurality of separately supported or relatively moving impellers.
- 171** This subclass is indented under subclass 170. Apparatus wherein the prime mover means for driving the impeller comprises a device which converts fluid energy to mechanical energy.
  - (1) Note. Included under this definition is an impeller which is driven by turbine blading directly connected to a working member of the impeller.
- 172** This subclass is indented under subclass 170. Apparatus wherein an impeller rotates in a reverse angular at regular intervals, the rotation in each direction extending through at least one complete revolution.
 

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

  - 69, for operator supported manually actuated impellers having a similar operative motion.
- 173** This subclass is indented under subclass 170. Apparatus wherein the impeller is operated by a motion transmitting means which is actuated by movement of an operator's hand or foot.
  - (1) Note. Included under this definition is a means actuated by an animal's extremity.
- 174** This subclass is indented under the class definition. Apparatus comprising a relatively fixed apparatus part against or in which an impeller\* or its supporting shaft is intended to continuously move and (1) means to conduct to or retain between said fixed and continuously moving parts a friction reducing material (2)

means to reduce or prevent undesired fluid flow into or out of the space between said fixed and continuously moving parts or (3) anti-friction fluid or solid means between said fixed and continuously moving parts to support said parts for relative movement.

- (1) Note. Excluded under this definition is a mere nominal recitation of the various means; a specific recitation of a particular\* means as defined above is necessary for classification in this subclass.

- 175** This subclass is indented under the class definition. Apparatus comprising at least two impellers\* or working members\* which differ significantly in structure other than by size or orientation.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

- 120+, for a plurality of impellers mounted for relative motion or on independent supports, which impellers may differ significantly in structure (i.e., not mere size or orientation relative to a fixed point).
- 203, for working members which are unsymmetrical relative to a plane, i.e., they differ from each other in orientation or size.
- 176** This subclass is indented under the class definition. Apparatus wherein the impeller\* comprises a blade\* projecting radially outwardly from a hub or shaft or a flow passage which wholly confines the working fluid while in working engagement therewith, the blade or flow passage extending circumferentially at least substantially one complete flight around the hub or shaft and the peripheral edge of the blade or flow passage defining a spiral path about the hub or shaft axis.
 

**SEE OR SEARCH CLASS:**

  - 198, Conveyors: Power-Driven, subclass 625 and 657+ for similar impellers especially adapted for moving other-than-fluid materials.
- 177** This subclass is indented under subclass 176. Apparatus wherein the impeller comprises (1) a circumferentially continuous working fluid directing surface integral with the working

- members thereof or (2) a flow passage which wholly confines the working fluid while in working engagement therewith.
- 178** This subclass is indented under the class definition. Apparatus wherein the impeller\* comprises a plurality of blades supported solely at their axial ends by transverse annuli or rings.
- 179** This subclass is indented under the class definition. Apparatus wherein a rotary impeller\* comprises (1) a working fluid flow directing surface integral with the impeller\* and circumferentially continuous about the rotation axis or (2) a flow passage which wholly confines the working fluid while in working engagement therewith.
- (1) Note. Included under this definition is a device in which a surface or part of the working member forms a portion of the circumferentially continuous flow directing surface.
- (2) Note. Included in this and indented subclasses is a device which would inherently confine fluid, as defined, even though not so specifically disclosed.
- 180** This subclass is indented under subclass 179. Apparatus wherein the flow directing surface comprises a concave annular member defining a semicircle in cross section.
- 181** This subclass is indented under subclass 179. Apparatus wherein the circumferentially continuous medium flow directing surface has one or more apertures therein.
- 182** This subclass is indented under subclass 179. Apparatus comprising a working fluid flow directing surface transverse to the axis of rotation and having a continuous peripheral edge.
- 183** This subclass is indented under subclass 182. Apparatus comprising blades extending axially from the transverse flow directing surface which are (1) discontinuous in radial or circumferential extent or (2) formed of intersecting, angular portions.
- 184** This subclass is indented under subclass 182. Apparatus in which the radially extending surface is positioned between the ends of a working surface, the working fluid simultaneously entering or leaving the working surface in two streams parallel to the axis of rotation, in directions towards or away from each other on both sides of the radially extending surface.
- 185** This subclass is indented under subclass 182. Apparatus in which the transverse surface is substantially solid or continuous from the hub to the edge thereof.
- 186** This subclass is indented under subclass 185. Apparatus comprising an additional working fluid flow directing surface, spaced axially from the transverse surface and of annular form, the working members being positioned between two surfaces.
- 187** This subclass is indented under subclass 186. Apparatus in which the working member\* has a dimension along the axis of rotation which is substantially greater than the dimensions along a radius (transverse to the axis of rotation) or across the member (thickness), the plurality of such members arranged and spaced around the annular surface, the member being of substantially constant radial extent along its length and supported between the two surfaces distally from the axis of rotation.
- (1) Note. Typically, the working members are parallel to and equidistant from the rotational axis, i.e., drum type; however, included within this definition is an arrangement wherein the blades converge towards the axis, i.e., conical type.
- 188** This subclass is indented under subclass 185. Apparatus comprising a member of conical form extending axially from the transverse flow directing surface.
- (1) Note. The member need not be a cone; included under this definition is a member which varies in diameter but whose wall is concave from the large to the small diameter.
- 189** This subclass is indented under subclass 179. Apparatus wherein the flow directing surface comprises an axially extending member.

**190** This subclass is indented under subclass 189. Apparatus wherein the flow directing surface includes means for damping impeller vibration or means which facilitate impeller expansion and contraction.

**191** This subclass is indented under subclass 189. Apparatus wherein the flow directing surface comprises a continuous series of connected or adjacent elements.

**192** This subclass is indented under subclass 189. Apparatus wherein the flow directing surface includes flange means extending transversely of the rotation axis.

**193** This subclass is indented under subclass 189. Apparatus wherein the flow directing surface is spaced inwardly of the impeller periphery, as such resulting in an inner and an outer blade or series of blades arranged with reference to the rotation axis of the hub or shaft.

**SEE OR SEARCH CLASS:**

415, Rotary Kinetic Fluid Motors or Pumps, subclasses 77+ for a rotary kinetic fluid motor or pump in which the runner has blades extending inwardly and outwardly from a rotating annulus.

**194** This subclass is indented under the class definition. Apparatus wherein the impeller\* includes means supplemental to the main attaching means for (1) securing the working members\* to a hub or shaft or (2) attaching the working members to one another.

(1) Note. The lashing or attaching means is usually of limited axial extent and the flow confining function thereof is questionable. An attaching means which extends axially so that it would confine or direct a fluid is excluded from this subclass; see search note following.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

179+, for an axially extending shroud or web which confines fluid even though not so disclosed, but is inherent in the structure.

**195** This subclass is indented under subclass 194. Apparatus wherein the supplemental means is connected to the radial extremities of the working members.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

189+, for a flow confining rim or ring which inherently acts as lashing or connecting means between the working members; see the search notes in subclass 179.

**SEE OR SEARCH CLASS:**

415, Rotary Kinetic Fluid Motors or Pumps, subclass 91 for an annular runner having inwardly extending working members.

**196** This subclass is indented under subclass 194. Apparatus wherein the supplemental attaching means extends between working surfaces.

**197** This subclass is indented under the class definition. Apparatus wherein the blade\* comprises a dished working fluid\* impact surface which is arranged normal to the plane of rotation and to the fluid force direction.

**198** This subclass is indented under the class definition. Apparatus comprising a plurality of working members\* spaced longitudinally of a rotary shaft such that they rotate in different planes transverse of the shaft.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

175, for a device comprising a plurality of working members\* which differ from each other structurally, i.e., a characteristic other than size or orientation, and which may be spaced longitudinally along a shaft.

**199** This subclass is indented under subclass 198. Apparatus wherein the working members direct the fluid from opposed axial sides to either an axially inward or outward direction.

**SEE OR SEARCH THIS CLASS, SUBCLASS:**

184, for an impeller comprising a radially extending plate intermediate the ends

of a working surface, the working fluid entering or leaving the working surface on both sides of the plate in opposed axial directions.

**SEE OR SEARCH CLASS:**

415, Rotary Kinetic Fluid Motors or Pumps, subclasses 93+ for a rotary kinetic energy pump or motor comprising means to direct the working fluid to or from the impeller in axially opposed paths, usually for the purpose of end balancing the impeller.

**200** This subclass is indented under subclass 198. Apparatus in which a portion on one working member is angularly offset relative to the corresponding portion on another working member spaced axially therefrom.

**201** This subclass is indented under subclass 198. Apparatus wherein the longitudinally spaced working members are of unequal radial lengths.

**202** This subclass is indented under the class definition. Apparatus comprising one or more bladed\* working member\* surfaces projecting radially outward from a rotation axis and so arranged that the blade axis in a radially outward direction is significantly offset from a radius to the rotation axis.

**203** This subclass is indented under the class definition. Apparatus wherein the impeller comprises (1) a fluid reactive device which is asymmetrical relative to a plane, such as a plurality of blades\* unequally spaced about a rotary carrier\* or (2) a plurality of working members\* which differ in size, shape or orientation.

(1) Note. Included under (2) above are working members merely fixed in differing operative positions (i.e., pitch).

**204** This subclass is indented under the class definition. Apparatus comprising means for attaching a working member to a mounting such as a hub or shaft.

(1) Note. A specific recitation of the attaching means is required in a claim for placement in this and dependent sub-

classes, the mere claiming or “means for connecting the blade to the support” or similar broad recitation not being sufficient for original classification.

(2) Note. Packing or sealing members, per se, between the blade and its mounting do not comprise blade attaching means.

**SEE OR SEARCH CLASS:**

198, Conveyors: Power-Driven, subclass 643, for an endless belt or chain-like member adapted to lift a viscous fluid from a body thereof as a result of the property of the fluid to adhere to the member.

**205** This subclass is indented under subclass 204. Apparatus wherein the means for attaching the blade to its mounting permits selectively fixing the blade in one of a plurality of different positions.

**206** This subclass is indented under subclass 205. Apparatus comprising an aperture or well in the mounting into which a blade part is received and releasably secured by a spring element.

**207** This subclass is indented under subclass 205. Apparatus wherein an impeller blade is secured to its mounting by a pressing or wedging means which may be manually loosened permitting repositioning of the blade in a different operative attitude or relationship.

**208** This subclass is indented under subclass 207. Apparatus wherein the impeller blade is releasably secured between the separable elements of a two-part hub.

**209** This subclass is indented under subclass 205. Apparatus wherein an encasing jacket is secured to that blade part which is attached to the carrier.

**210** This subclass is indented under subclass 204. Apparatus in which the blade is attached to a radial carrier arm or annular mounting member and spaced at some distance from the hub or shaft.

- 211 This subclass is indented under subclass 210. Apparatus wherein the blade projects from the carrier arm in a direction substantially parallel to the axis of the hub or shaft.
- 212 This subclass is indented under subclass 204. Apparatus wherein the impeller comprises a plurality of blades, any one blade provided with means interfitting or common to an adjacent blade to produce rigidity in one or more directions.
- 213 This subclass is indented under subclass 204. Apparatus wherein the blades are attached to the hub or shaft by fusion (e.g., welding, etc.) or adhesive bonding.
- 214 This subclass is indented under subclass 204. Apparatus wherein the blade is secured between two spaced surfaces which may be disassociated or disconnected from each other.
- 215 This subclass is indented under subclass 204. Apparatus wherein the mounting is provided with a circumferentially extending recess into which a portion of the blade is securely received.
- (1) Note. The circumferential slot may be disposed on the periphery or end wall of the carrier\*.
- 216 This subclass is indented under subclass 215. Apparatus in which the blade portion and channel wall, or a packing or securing means therebetween, have a plurality of elongated, radially spaced, interfitting channels and ridges.
- 217 This subclass is indented under subclass 215. Apparatus in which the portion of the blade that is received by the mounting comprises a plurality of distinct fingers or projections extending from the main body of the blade.
- 218 This subclass is indented under subclass 215. Apparatus comprising a distinct and separate circumferentially extending member which secures or fastens a plurality of blades to each other or to the channel wall.
- (1) Note. The circumferentially extending member may be of rod or sheet configuration (e.g., wire, wedge, or packing or sealing means).
- 219 This subclass is indented under subclass 204. Apparatus wherein the mounting is provided with recesses or grooves which securely receive a blade portion.
- 220 This subclass is indented under subclass 219. Apparatus comprising a distinct fastening member for securing the blade to the mounting.
- 221 This subclass is indented under subclass 220. Apparatus wherein the fastening member comprises elastic or distortable material.
- 222 This subclass is indented under subclass 204. Apparatus in which the blade has attaching portions at the inward extremity thereof which depend on either side of a continuous supporting surface.
- 223 This subclass is indented under the class definition. Apparatus in which the shape, composition or construction of an impeller blade\* is specifically recited in a claim.
- (1) Note. Patents from Class 415, Rotary Kinetic Fluid Motors or Pumps, subclasses 182.1 and 208.1 - 232, have been cross referenced to this and indented subclasses where particular runner blade structure is claimed. To complete a search for blade shapes, structures, materials, attaching means, etc., appropriate subclasses in Class 415 excepting those noted above, should be considered.
- SEE OR SEARCH CLASS:  
428, Stock Material or Miscellaneous Articles, subclasses 544+ for stock materials, e.g., of indefinite length, which are all metal or have adjacent metal components.
- 224 This subclass is indented under subclass 223. Apparatus wherein the blade has an abrasion resistant liner, sheathing or insert secured to a portion thereof normally subject to erosive deterioration.
- (1) Note. The abrasion resistant means must be supplemental to basic blade forming structure and a specifically claimed

blade structure accompanied by a mere disclosure that the outer blade surface is resistant to wear is properly classified elsewhere on the basis of the particular blade structure defined.

**SEE OR SEARCH THIS CLASS, SUB-CLASS:**

229+, for a laminated or encased material blade wherein the outer layer or covering may be disclosed as resistant to abrasion.

241+, for a blade coating or composition which may be disclosed as resistant to abrasion.

**225** This subclass is indented under subclass 223. Apparatus wherein the blade includes reinforcing means extending longitudinally thereof serving to compress the blade parts and resist the action of longitudinal forces (e.g., centrifugal) thereon.

**226** This subclass is indented under subclass 223. Apparatus wherein the blade is fabricated by securing portions thereof to a main member which extends longitudinally of the blade from the root end to the tip, said member supporting the weight of the blade and carrying the stress forces exerted thereon.

**227** This subclass is indented under subclass 223. Apparatus wherein the blade (1) comprises plural parts held at spaced intervals, (2) is so shaped as to define or enclose an open area, or (3) comprises a solid member discontinuous in at least one direction.

(1) Note. This definition does not include a mere apertured blade or one comprised or permeable material, such structure being classifiable in subclass 231 below.

**SEE OR SEARCH THIS CLASS, SUB-CLASS:**

69+, particularly subclasses 76+ for operator supported manually actuated impellers, many of which comprise open work type reaction members.

**SEE OR SEARCH CLASS:**

52, Static Structures (e.g., Buildings), subclasses 633+ for open work structures of general utility and see the

search notes thereunder for similar structure elsewhere classifiable.

**228** This subclass is indented under subclass 223. Apparatus wherein the impeller\* (1) comprises a plurality of elongate rod-like working members\* projecting from a common carrier\* or (2) is so shaped as to define an edge outline which markedly deviates from a smooth configuration.

**229** This subclass is indented under subclass 223. Apparatus wherein the impeller blade (1) is fabricated by bonding or fastening together a plurality of layers of material, (2) comprises a structural part, such as a stiffening member, set within a constituent part of the blade as by being molded therein, or (3) comprises blade forming material enclosed within a shell or casing.

**230** This subclass is indented under subclass 229. Apparatus wherein the blade comprises, at least in part, individual elongated threadlike members of metal or other matter or such members twisted or woven together to form a rope, cable, cloth or like structure.

**231** This subclass is indented under subclass 223. Apparatus wherein the working member (1) has one or more openings extending there-through or (2) is made up of material which is intended to permit the flow of fluid there-through.

**SEE OR SEARCH THIS CLASS, SUB-CLASS:**

90+, for blades having fluid intake or discharge openings thereon and see (2) Note thereunder.

227, for blades of open work, or lattice or loop forms.

**232** This subclass is indented under subclass 223. Apparatus wherein the blade comprises a shell which defines a blade cavity.

**SEE OR SEARCH THIS CLASS, SUB-CLASS:**

90+, and 96+, for blades having fluid flow conducting passages therein.

- 233** This subclass is indented under subclass 232. Apparatus wherein the shell encloses ribs or like reinforcing means extending between opposing walls of the cavity.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 226, for a hollow blade wherein the shell is fabricated about a main support.

- 234** This subclass is indented under subclass 223. Apparatus wherein the impeller blade is so shaped from or joined to carrier means therefor as to blend smoothly therewith.

- 235** This subclass is indented under subclass 223. Apparatus wherein the blade surface (1) deviates from a smooth symmetric shape, (2) has rib or rim means thereon or (3) is so configured as to form a channel.

- 236** This subclass is indented under subclass 235. Apparatus wherein the blade surface has rib means thereon or has grooves shaped therein.

- 237** This subclass is indented under subclass 235. Apparatus wherein the blade comprises two or more flat surfaces which (1) intersect in an angular relationship or (2) lie in different but substantially parallel planes united by a blade portion normal to the said surfaces.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 183, for an impeller comprising a radially extending flow directing surface and a blade having circumferentially or radially offset parts.

- 238** This subclass is indented under subclass 223. Apparatus wherein the blade axis is swept axially or circumferentially from the juncture of the blade with the carrier\*.

- 239** This subclass is indented under subclass 223. Apparatus comprising (1) fairing structure supported adjacent the inner end of the blade or (2) the specific shape or construction of the lower portion of the blade intermediate the reaction surface and the root, as in Fig. II in the Class Definition of this class.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 234, for impeller blading integral with and smoothly blended into the carrier or which comprises, in effect, a shaped hub.  
248, for subject matter directed to blade root structure or to a root block, the impeller blade being either nominally recited or not claimed.

- 240** This subclass is indented under subclass 223. Apparatus wherein the impeller blade comprises pliant material so that in its finished form it has a high degree of flexibility.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 81, for an oscillatory working member comprised of pliant material.  
84, for a working member having collapsible walls expansible to an operative shape by filling with a fluent material.

- 241** This subclass is indented under subclass 223. Apparatus wherein (1) an initially fluent substance is applied to the blade surface so as to leave a residual film, layer or continuous deposit thereon or which penetrates the blade base material and is at least partially retained therein or (2) the material composition of the blade is specifically set forth or (3) a specific structural characteristic of the blade (other than shape) is set forth, such feature not being elsewhere classifiable.

- (1) Note. Under part (2) the mere recitation that the blade is formed of metal or wood is excluded since such subject matter is extremely common in this art.

SEE OR SEARCH CLASS:

- 415, Rotary kinetic Fluid Motors or Pumps, subclass 216.1 for a working fluid\* passage or distributing means for a runner\* has a specific shaft\* shape or material, subclass 217.1 for a working fluid\* passage or distributing means for a runner\* has a corrosion resistant or nonmetallic portion.  
420, Alloys or Metallic Compositions, appropriate subclasses for a specific alloy. Class 75 takes a nominally

- claimed impeller blade formed of a specific alloy.
- 428, Stock Material or Miscellaneous Articles, appropriate subclasses, for coated articles; Class 428 takes an impeller blade nominally claimed with a specific coating on a surface thereof, subclasses 551+ for stock material having plural adjacent metallic components, metal particles, and an additional nonmetal component.
- 242** This subclass is indented under subclass 223. Apparatus wherein a surface of the blade is curved in two or more directions, (e.g., sinusous).
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
235+, for an impeller blade having an undulating or rippled surface.
- 243** This subclass is indented under subclass 223. Apparatus wherein a face of the blade comprises an inwardly curved surface.
- 244** This subclass is indented under the class definition. Apparatus comprising impeller\* having (1) support\* structure, (2) securing means not provided for above, (3) carrier\* structure or (4) drag or head resistance reducing means such as a smooth outline member or covering supported on the impeller carrier.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
85+, for a float supported impeller.  
93+, for hub, fairing or housing structure including means whereby ambient fluid or exhaust gas is caused to flow therethrough.  
234, for impeller blading integral with and smoothly blended into the carrier or which comprises, in effect, a shaped hub.  
239, for impeller blading having fairing structure supported at the inner end thereof or wherein the blade shank itself is so shaped.
- SEE OR SEARCH CLASS:  
415, Rotary Kinetic Fluid Motors or Pumps, subclass 216.1 for a device comprising a runner\* supported on a shaft of specific shape or material and further comprising working fluid\* passage or distributing means for the runner, subclass 218.1 for a device including a runner comprising a conical hub having its small diameter portion facing upstream and further including working fluid passage or distributing means for the runner.
- 245** This subclass is indented under subclass 244. Apparatus comprising a conical member coaxially mounted on the impeller shaft or hub proximate the blading such that the apex of said conical member comprises either the upstream or downstream terminus of the impeller.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
93+, for hub, fairing or housing structure (which may be for aircraft) including means whereby ambient fluid or exhaust gas is caused to flow there-through.
- 246** This subclass is indented under subclass 244. Apparatus wherein an impeller is mounted on a support for movement to various positions of use or to a nonuse position.
- SEE OR SEARCH THIS CLASS, SUBCLASS:  
85+, for an impeller adjustably supported on a float.
- 247** This subclass is indented under the class definition. Apparatus wherein an obstructing member or open frame structure is located adjacent or about the impelling means to prevent contact of the impelling means by foreign objects or by animals.
- (1) Note. Included under this definition of a protective screen or guard is a device to confine spray or splash caused by motion of the impeller and to prevent such spray or splash from impinging on adjacent surfaces.
- SEE OR SEARCH CLASS:  
440, Marine Propulsion, subclasses 71+ for screw propeller guard means limited to vessel propulsion and see Class

Definition of this class (416) for a general statement of the line.

**248** This subclass is indented under the class definition. Apparatus not otherwise provided for above.

- (1) Note. For example, this subclass includes a part of member located intermediate the shank of an impeller blade\* and a carrier\* therefor, said part of member being commonly termed the blade root or root block and not classifiable elsewhere.

#### CROSS-REFERENCE ART COLLECTIONS

The following subclasses are collections of published disclosures pertaining to various specified aspects of the Fluid Reaction Surfaces (i.e., Impellers), art which aspects do not form appropriate bases for subclasses in the foregoing classification (i.e., subclasses superior hereto in the schedule), wherein original copies of patents are placed on the basis of proximate function of the apparatus. These subclasses assist a search based on remote function of the apparatus and may be of further assistance to the searcher, either as a starting point in searching this class or as an indication of further related fields of search inside or outside the class. Thus, there is here provided a second access for retrieval of a limited number of types of disclosures.

- (1) Note. Disclosures are placed in these subclasses for their value as references and as leads to appropriate main or secondary fields of search, without regard to their original classification or their claimed subject matter.
- (2) Note. The disclosures found in the following subclasses are examples, only, of the indicated subject matter, and in no instance do they represent the entire extent of the prior art.

**500** An impeller\* or working member\* which is so designed or includes means associated therewith for the purpose of reducing undesirable vibrational motion induced by the operation thereof.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

194+, for means securing the working members to one another or to a hub or shaft for purposes of reducing vibration during normal operation.

**501** An impelling member formed of loose flexible material, usually in divided or sectional form, such that movement of the member produces a rustling sound effect in addition to a current of air scare or brush away flies and the like.

SEE OR SEARCH CLASS:

43, Fishing, Trapping, and Vermin Destroying, subclasses 132.1+ for insect destroying devices and processes in general.

160, Flexible or Portable Closure, Partition, or Panel, for subject matter of that class combined with a fly brush type impeller

END